

This page is for information only – not to be printed

# LPKF *BoardMaster* 3.0 Manual

As at: 16.11.97

TrueType fonts used in this document:

- Arial
- Arial Narrow
- Symbol
- Wingdings

Pages: 70  
Filename: Bm-Handbuch\_en.doc  
File size: 4512768 bytes  
Format: Word for Windows 6.0/7.0

Authors: Hans Erich Plock / Stephan Schmidt  
Layout: Torsten Gatzemeier





# **BoardMaster**



Version 3.0

September 1997

## **Manual**

### **English Version**

© LPKF Laser & Electronics AG

1991 - 1997

All rights reserved

LPKF Laser & Electronics AG

Osteriede 7

30827 Garbsen, Germany

Tel: ++49-(0)5131-7095-0

Fax: ++49-(0)5131-7095-90

The information contained in this document may be modified without prior notification. No part of this document may be reproduced or transmitted for any purpose or in any form by any means, electronic or mechanical, by photocopy, by recording or by information storage and information retrieval systems without the express written permission of LPKF.

We have taken great trouble to ensure the accuracy and completeness of the information in this document. However, LPKF accepts no liability for the use of the document, including breach of copyright or other infringement against third parties which may arise from this.

© 1998 LPKF Laser & Electronics AG. All rights reserved.

As at: 16.11.1997

---

# Table of contents

---

<b>About this manual</b>	<b>6</b>
Conventions.....	6

---

<b>Safety notes</b>	<b>7</b>
---------------------	----------

---

<b>Installation</b>	<b>8</b>
System requirements .....	8
Materials supplied .....	8
Installation.....	8
Folders created during installation.....	10

---

<b>Getting started</b>	<b>11</b>
Starting <i>BoardMaster</i> .....	11
Plotter standby mode.....	11
The Wait message .....	12
<i>BoardMaster</i> user interface .....	12

---

## **The Menu bar 14**

The CONFIGURATION menu .....	14
Serial interface .....	14
Circuit board plotter .....	16
Tool parameters .....	20
The Heads dialog box .....	22
Production phases .....	24
Board material size.....	25
The MOVE TO menu .....	27
The FILE menu .....	28
The EDIT menu .....	29
Tool assignment.....	29
Placing projects.....	31
The VIEW menu .....	33

---

## **The Toolbar 34**

Status information .....	34
Variable parameters.....	35
Placement functions .....	36
Control functions for manual control.....	37
Select production phase .....	39
Tool change.....	40
Circuit board plotters with manual tool change .....	40
Circuit board plotters with automatic tool change.....	41
Selection functions.....	42
Control functions for the production phase.....	43

---

<b>Special functions</b>	<b>45</b>
for LPKF AutoContac .....	45
for ProtoMat® 95s .....	51
The Teach In dialog box .....	54
The Reload Material dialog box .....	56

---

<b>Step by Step</b>	<b>58</b>
---------------------	-----------

---

<b>Index</b>	<b>61</b>
--------------	-----------

# About this manual

This manual is an introduction into the operation of *BoardMaster 3.0 for Windows™*.

LPKF *BoardMaster* is a program for the automatic control of HP-GL compatible LPKF circuit board plotters.

LPKF *BoardMaster* is capable of importing production data generated by LPKF *CircuitCAM* in LMD format and production data generated by other programs in HP-GL format, of displaying this data graphically on the screen and processing it together with process and job information.

The circuit board plotter is fully controlled through *BoardMaster*. The *WYSIWYG* (What You See Is What You Get) representation of the data to be processed, the manual control of the circuit board plotter through the Windows interface and the incorporated tool library with all the requisite information guarantees largely automatic prototype production.

This manual will guide you from the LMD/HP-GL circuit board data created by *CircuitCAM* or other programs, through job preparation, to the production of the circuit board prototypes with the circuit board plotter. You will be guided step by step through the program; at critical points in the program we will point out possible sources of errors that might arise because of the structure of the various data sources. In this way, we hope to allow you to identify errors correctly from the outset and to avoid them by defining the important parameters correctly.

## Conventions

The following conventions have been followed to assist your orientation within this manual:

SMALL CAPITALS	identify the name of a menu term, a dialog box or an input field
<b>BOLD SMALL CAPITALS</b>	identify a list field entry
<i>italic script</i>	identifies a technical term or a proper name
<b><i>bold italic script</i></b>	identifies a keyboard input
<b>&lt;...&gt;</b>	identifies a key on the keyboard, eg <b>&lt;F4&gt;</b> is the label for function key F4

---

### Note for newcomers to Windows:

This tutorial does not cover the basic operation of the *Windows* interface. Please first refer to your *Windows* documentation if you are not familiar with the techniques of handling *Windows* objects.

---

---

### Note on the illustrations:

The illustrations are sometimes shown here in different colours from the way they appear on your screen to improve reproduction in this manual.

---



# Safety notes

The following points must be observed without fail to ensure your safety. Of course, the use of *BoardMaster* on its own constitutes only a very slight hazard potential.

## Caution

**Make sure that your computer is plugged into the main supply properly and correctly connected to the circuit board plotter.**

**Make sure that no-one enters the working area of the circuit board plotter while data transfer between BoardMaster and the circuit board plotter is taking place.**

**Make sure that no-one can access the working area of the circuit board plotter or come into contact with the tools while the operations controlled by BoardMaster are being executed.**

**Make sure, when working on the circuit board plotter, for example when changing tools manually or lining up the board material, that it is impossible for an unauthorized person to operate BoardMaster.**

**In an emergency, switch off the circuit board plotter and the PC connected to the circuit board plotter immediately.**

**You must also follow the safety instructions given in the manual for the circuit board plotter .**

**You should also take account of additional safety instructions in this manual.**

# Installation

## System requirements

***The minimum system requirements for an installation of BoardMaster are:***

IBM PC or compatible system with

- 386 processor
- 8 MB RAM
- VGA colour monitor (recommended resolution 1024 x 768 pixels)
- Microsoft Windows 3.1x or higher
- 3.5" floppy drive

*BoardMaster* requires approximately 4 MB free hard disk space for its installation.

## Materials supplied

The materials supplied with *BoardMaster* include:


- two 3.5" program disks
- this manual


## Installation

*BoardMaster* is installed from the 3.5" diskette no. 1 under *Windows*. The diskettes contains all the programs and files necessary for the correct operation of *BoardMaster*.

<b>Note:</b>	Make sure that you have made a copy of the program disks and that you install from this copy.
--------------	---

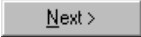
### ***How to install BoardMaster:***

1. Insert the **program disk 1** in your floppy drive.
2. Select RUN from the WINDOWS START menu.
3. Enter the DRIVE LETTER of your floppy drive followed by **:setup** (eg **a:setup**) in the text field of the **Run** dialog box.
4. Click on  to start the installation routine.

<b>Note:</b>	Clicking on  allows you to close the dialog box and cancel the installation.
--------------	---

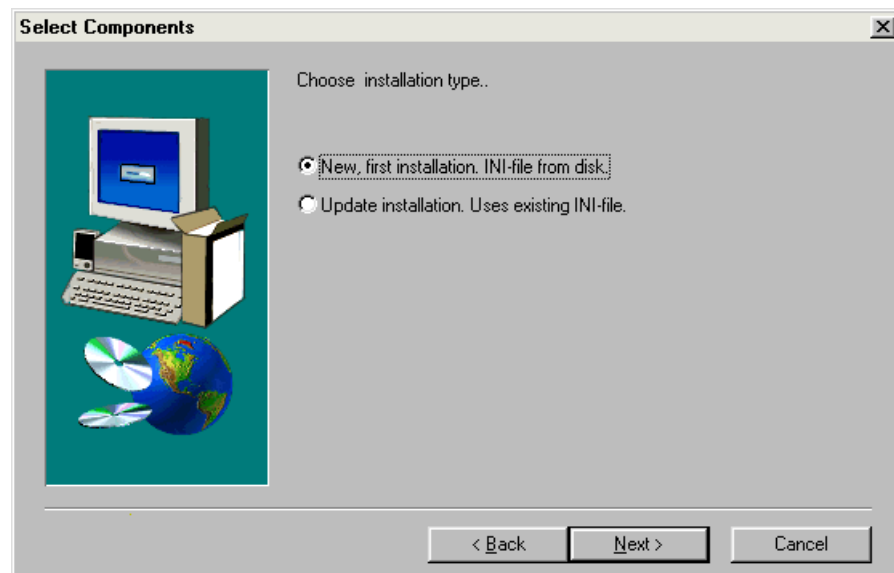
5. Follow the instructions of the installation program.

**Tips & tricks:** Selecting the circuit board plotter in the CIRCUIT BOARD PLOTTER TYPE list box will cause the appropriate initialization files to be assigned to *BoardMaster*. These setup initialization files (\*.MCH) contain information relating to the circuit board plotter being used (resolution, maximum speed, working area etc.), the tool libraries and the various production phases. These items will be dealt with in detail below.

6. Click on  to continue the installation routine.
7. Follow the further instructions of the installation program.

### ***New or Update Installation***

During the *BoardMaster* installation occurs the following Window:



Choose “New, first installation” if you want to install *BoardMaster* and your Circuit Board Plotter the first time on this computer. The setup program will ask you to insert the configuration disk into drive A:, which has been delivered with your Circuit Board Plotter and contains the individual INI-file. If you don’t want to use your configuration disk to install *BoardMaster* with default parameters, press ESC.

Choose “Update installation” if you want to use an already existing INI-file on your system. You will be asked to specify the directory which contains the valid initialization file. Press ESC to install *BoardMaster* with default parameters.

#### **Note for update customers:**

The initialization files (\*.INI) for your existing version of *BoardMaster* will be updated during installation, but your user-specific settings will be retained.

If you install *BoardMaster* with default parameters you have to initialize the Circuit Board Plotter and set the home position for proper operation. See Chapter *Circuit Board Plotter* for details.

## Folders created during installation

By default, the installation program creates an “LPKF30” directory to which the program files for *BoardMaster* are saved.

The following subdirectories will be created in the LPKF30 directory:

- **BMaster**  
contains all program files for *BoardMaster* as well as all necessary configuration files.
- **Data**  
this is used as the working folder for *BoardMaster*. This working folder already contains some sample files for *BoardMaster* and may be used as standard directory to save data from *CircuitCAM*.

# Getting started

In this chapter, we should like to give you a first look at *BoardMaster* and familiarize you with the *BoardMaster* user interface.

**Note:** This manual uses the default settings suggested during the installation for the name of the program group and the folders created.


## Starting *BoardMaster*

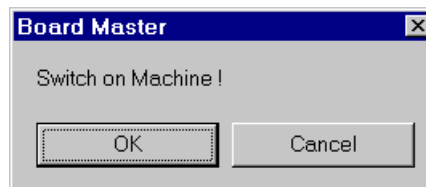
Following installation of *BoardMaster*, you will find a new program group called LPKF30 in the PROGRAM MANAGER.

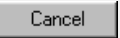
### **How to start *BoardMaster*:**

Double-click on the BOARDMASTER 3.0 icon in the LPKF PROTOTYPING program group in PROGRAM MANAGER.

## Plotter standby mode

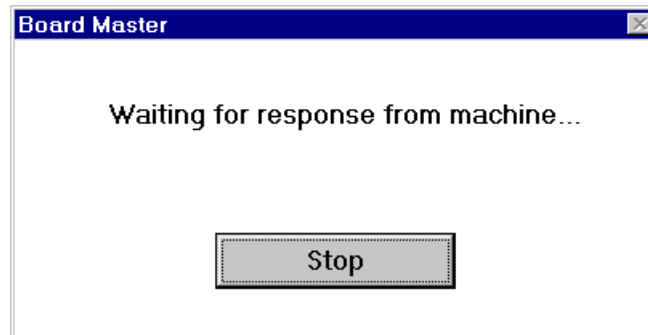
Once LPKF BoardMaster has been started, you will see a prompt to switch on the circuit board plotter (machine) and to confirm by clicking on 



**Caution** Clicking on  causes the program to continue whatever the response from the circuit board plotter and can lead to data loss.

## The Wait message

A box with the relevant message will be displayed on screen all the time BoardMaster is waiting for a response from the circuit board plotter:

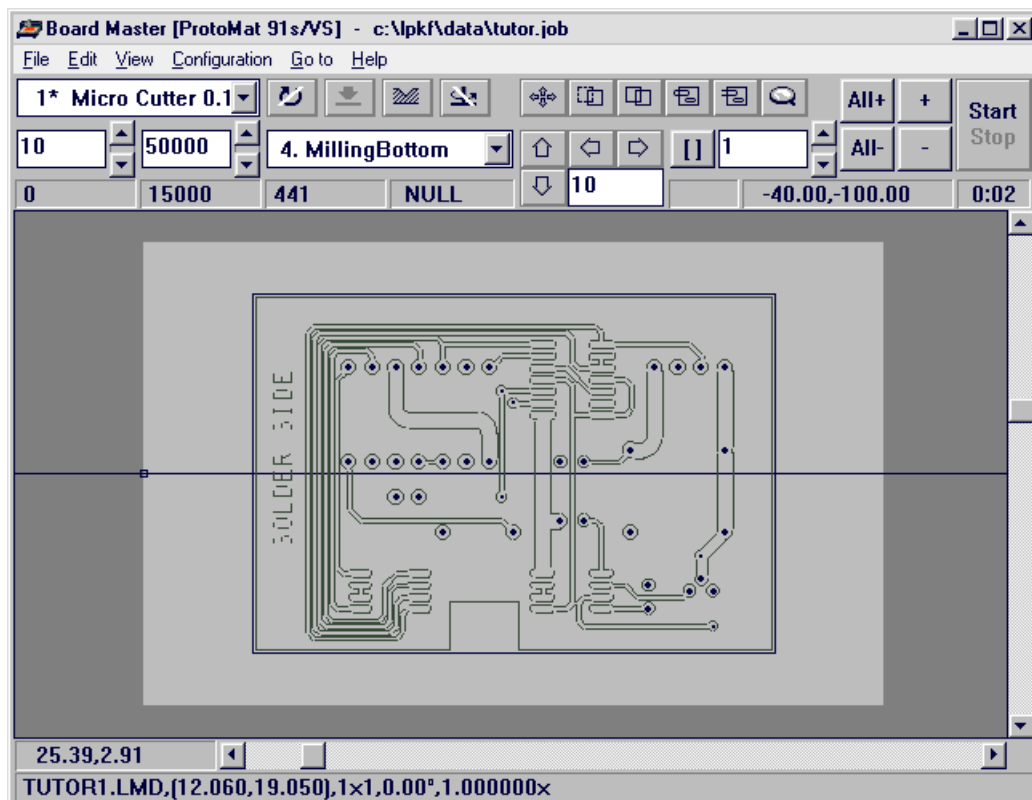


This message appears if *BoardMaster* is started and the circuit board plotter is not switched on. The message will disappear once the machine is switched on and the head has reached the tool change position. However, *BoardMaster* sets the interface to NULL if **Stop** is clicked.

The message will also be displayed if the machine is still busy processing the last command from the command buffer. This is **not an error message**. It is possible to change to other applications while this message is being displayed. As soon as the plotter sends the response required to the PC, the message disappears and the program continues as normal.

## BoardMaster user interface

The illustration shows the *BoardMaster* user interface with the job "tutor.job" already loaded:



**Tips & tricks:** A completely prepared production file, containing information regarding copper board material size, LMD- or HP-GL files used, their placement and all production phases and tool assignments is referred to as a job .

The structure of a job file will be described in greater detail in the sections below.

You can open the “tutor.job” file for testing and practice purposes after you have started *BoardMaster* by selecting OPEN from the FILE menu.

The *BoardMaster* user interface is divided up into a number of areas:

The **Title bar** shows the name of the program and specifies the circuit board plotter type in use and the name of any job that has been loaded or freshly created.

The **Menu bar** lists the menus available.

The **Toolbar** contains various buttons, displays and functions for controlling the circuit board plotter and for modifying a job.

The **Workspace** shows the current view of the circuit board plotter in graphical form. This area is for its part divided into the actual **working area** of the circuit board plotter (shown in dark grey) and the area of the **board material** in use (shown in light grey) with the **circuit board data** to be processed. You can customize the graphical representation of the workspace to your requirements using the VIEW menu functions.

The **Scroll bars** beneath and to the right of the workspace can be used to move the visible detail around the workspace.

The **current mouse pointer position** is shown on the left by the horizontal scroll bar.

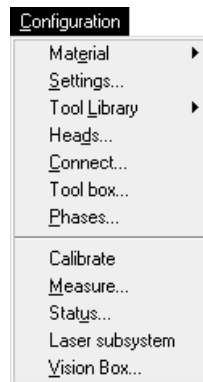
The **Status bar** beneath the horizontal scroll bar shows information about the buttons, displays or areas where the mouse pointer is currently located.

# The Menu bar

In this chapter we should like to introduce you to the menu functions in *BoardMaster* in a typical sequence in which they might be used.

## The CONFIGURATION menu

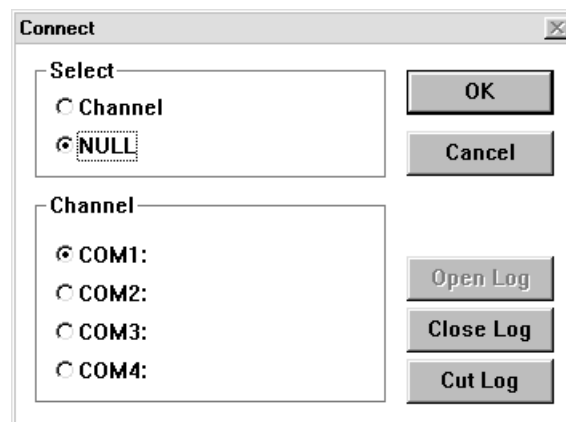
This menu groups together all the functions you might need in configuring *BoardMaster* and the connected circuit board plotter:



## Serial interface

**CAUTION:** Make sure that no-one can access the working area of the circuit board plotter during the configuration procedure, as changing to the correct interface could cause a data transfer and thus cause the circuit board plotter to start.

Open the CONFIGURATION menu and select the INTERFACE... line to open the following dialog box:



Use this dialog box to choose the communication port to which your circuit board plotter is connected. The default setting is NULL, i.e. no communication takes place through the serial interface.



- NULL** Click on this radio button to use *BoardMaster* on a PC without a circuit board plotter connected to it. (For test operation and for preparing the data.)
- INTERFACE** Click on this radio button to use the COM1 to COM4 radio buttons to specify the serial interface to which your circuit board plotter is connected.

The serial interface parameters to be set for the various circuit board plotters are listed in the table below:

Circuit board plotter	Baud rate	Data bits	Stop bits	Parity	Protocol
LPKF 91, 92 LC LC/VS HI-P Automill	4800	8	1	none	Flow Control
LPKF 91s, 92s ProtoMat® 91s, 91s/VS, 92s, 93s, 95s	9600	8	1	none	Flow Control

These parameters are set up in the Windows Control Panel.

- Windows 3.1:* under PORTS
- Windows 95:* under SYSTEM - DEVICE MANAGER - PORTS
- Windows NT:* under PORTS

The first time it is started, *BoardMaster* sets all the relevant interface parameters itself. It even automatically disables the FIFO mode for the interface selected. *BoardMaster* may then prompt you to reboot the system to make sure that all the settings are effective.

The FIFO mode of the relevant serial interface cannot be disabled automatically under Windows NT. Please use EXTENDED PORT SETTINGS in CONTROL PANEL - PORTS to disable the FIFO mode.

**Tips & tricks:** Check the connection between the PC and the circuit board plotter if the circuit board plotter is not being controlled correctly after data transfer is started.

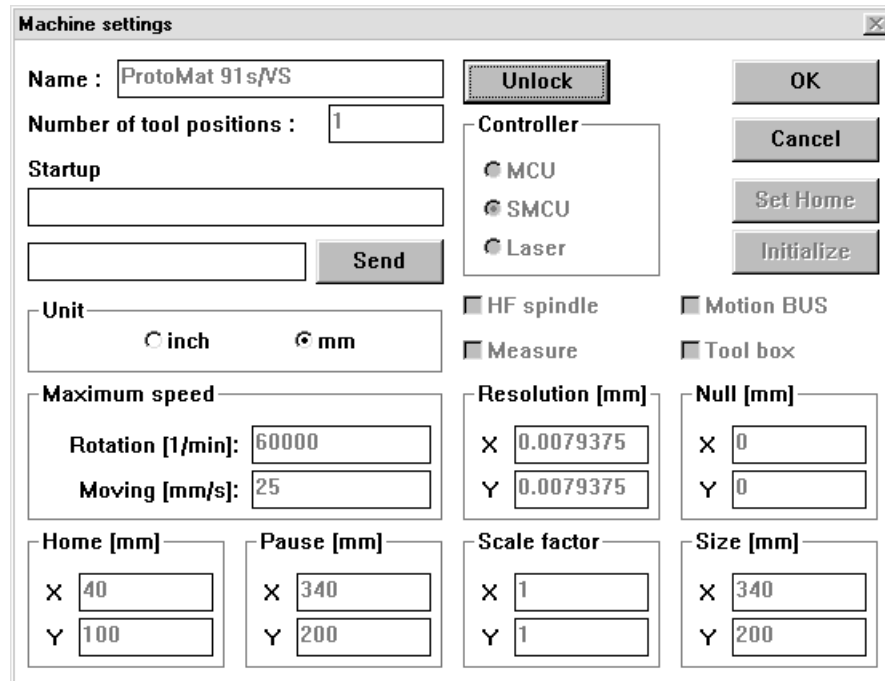
You should also make sure that the parameters for the serial interface in Windows Control Panel match the parameters listed in the table.

An incorrectly specified protocol for the serial interface is a frequent cause of defective communication. Make sure that *Flow Control* and not *XON/XOFF* is selected as the protocol.

## Circuit board plotter

Once the interface has been set up, you will have to import or set the plotter parameters necessary for correct operation.

Open the CONFIGURATION menu and select the PARAMETER... line to open the following dialog box:



The 'Machine settings' dialog box contains the following fields and controls:

- Name :** Text field with 'ProtoMat 91s/VS'.
- Number of tool positions :** Text field with '1'.
- Startup:** Two empty text fields.
- Unit:** Radio buttons for 'inch' and 'mm' (selected).
- Maximum speed:**
  - Rotation [1/min]:** Text field with '60000'.
  - Moving [mm/s]:** Text field with '25'.
- Home [mm]:**
  - X:** Text field with '40'.
  - Y:** Text field with '100'.
- Pause [mm]:**
  - X:** Text field with '340'.
  - Y:** Text field with '200'.
- Scale factor:**
  - X:** Text field with '1'.
  - Y:** Text field with '1'.
- Size [mm]:**
  - X:** Text field with '340'.
  - Y:** Text field with '200'.
- Controller:** Radio buttons for 'MCU' (selected), 'SMCU', and 'Laser'.
- HF spindle:** Check box (unchecked).
- Measure:** Check box (unchecked).
- Motion BUS:** Check box (unchecked).
- Tool box:** Check box (unchecked).
- Resolution [mm]:**
  - X:** Text field with '0.0079375'.
  - Y:** Text field with '0.0079375'.
- Null [mm]:**
  - X:** Text field with '0'.
  - Y:** Text field with '0'.
- Buttons:** 'Unlock', 'OK', 'Cancel', 'Set Home', 'Initialize', and 'Send'.

This dialog box is used to define all the plotter-specific parameters and to save them to the initialization file (\*.INI). LPKF supplies circuit board plotters with two different types of controller:

- LPKF 91, LPKF92, LC, LC/VS, HI-P, Automill with *MCU* controller
- LPKF 91s, LPKF92s, ProtoMat<sup>®</sup> 91s, ProtoMat<sup>®</sup> 91s/VS, ProtoMat<sup>®</sup> 92s, ProtoMat<sup>®</sup> 93s and ProtoMat<sup>®</sup> 95s with *SMCU* control

The laser is a third controller type. Use this operating mode if *BoardMaster* is being used with an LPKF *StencilLaser*, *Multifunction laser* or *Hybrid laser*.


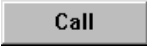
*BoardMaster* is capable of operating all three types of controller. The controller type is selected in the CONTROLLER group box and is preset for the circuit board plotter selected during setup.

**Tips & tricks:** The controller type should not be changed, as otherwise correct data transfer with the appropriate syntax will no longer be possible.

To prevent accidental changes to a parameter listed in the MACHINE PARAMETERS dialog box, you are required to click the **Unlock** button to allow editing of a parameter before you undertake any intentional modification.

***Machine parameter setting for MCU controller  
(only 101 LC, LC/VS, Hi-P, Automill)***

All the important parameters for circuit board plotters with *MCU* controllers such as the *HOME* position (data origin) and the size of the workspace are stored in battery-buffered RAM after plotter initialization. This data must be downloaded from the circuit board plotter before you start working with *BoardMaster*.

1. Click on  to allow modifications to machine parameters.
2. Click on  to download the parameters from the circuit board plotter.

**Tips & tricks:** It is only possible to download the data from the circuit board plotter if the circuit board plotter controller is switched to *Select*.

Unless the origin of the circuit board plotter and/or the serial interface used is changed, definition of the connection and reading the *HOME* position and the working area is a one-time process, as this information is stored in the initialization file (\*.INI) when you close *BoardMaster*.

The parameter values downloaded from the circuit board plotter are displayed in the *ORIGIN*, *SIZE*, *HOME* and *PAUSE* text boxes. The data in the *NULL* and *SIZE* text boxes are fixed values which are plotter-dependent and cannot be edited. The data in the *HOME* and *PAUSE* text boxes may be edited.

**Tips & tricks:** Changing the *HOME* position only causes the display in the workspace to change; it has no effect on the positioning of the data on the circuit board plotter, as the relevant *HOME* position for the circuit board plotter is stored in the controller.


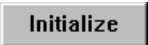
It may be appropriate to modify the *Pause* position if it is to differ from the default setting (Xmax/Ymax), eg Xmax/Ymin.

### **Machine parameter settings for SMCU control (LPKF 91s, LPKF 92s and all ProtoMat® models)**

The machine parameters for your plotter are read during installation from the initialization disk that was supplied with your circuit board plotter. This means that all the important data for the machine size and the location of the HOME Position (data origin on the mirror axis) are already programmed in the factory. Please follow the instructions below if you wish to set these parameters or correct them.

All the important information such as the *HOME* position and the working area must be sent to the circuit board plotter controller by *BoardMaster*. The circuit board plotter must be initialized the first time it is used:


<b>Caution</b>	<b>The following instruction starts the circuit board plotter.</b>  <b>Make sure that no-one can access the working area of the circuit board plotter.</b>  <b>You should also take account of additional safety instructions in the circuit board plotter manual.</b>
----------------	--

1. Click on  to allow modifications to machine parameters.
2. Click on  to start the initialization run.

The plotter head approaches the limit switches for all four travel directions during the initialization run and sends the values determined in this way back to *BoardMaster*. These values are displayed in the *ORIGIN* (Xmin/Ymin, always 0/0) and *SIZE* (Xmax/Ymax) text boxes. These entries cannot be edited, they can only be reset by initialization.

The values in the *PAUSE* text box are identical with the values in the *SIZE* text box. They can, however, be edited to place the *Pause* position at any chosen point.

<b>Note:</b>	The values in the <i>HOME</i> (data origin) are set by default to Xmin and Ymax/2. The <i>HOME</i> values determined in this way are not the precise values which will ensure that the solder side and component side will coincide in the production of double-sided circuit boards. It is necessary to ensure that the <i>HOME</i> position lies precisely on the mirror axis of the plotter, which is established by the two alignment pins, to achieve this effect.
--------------	---



3. Set up the *Home* position on the mirror axis of the circuit board plotter.  
(You can find information on how to do this in the circuit board plotter manual.)
4. Click on  to set the *Home* position to the current position of the circuit board plotter's head.

<b>Tips &amp; tricks:</b>	We recommend that you make a note of these values so that it is not necessary to set up the <i>HOME</i> position on the circuit board plotter if the values are accidentally changed.
---------------------------	---

A command chain in the plotter syntax can be entered in the *START LINE* text box. This will be stored in the initialization file when you exit from *BoardMaster* and sent to the circuit board plotter each time you start *BoardMaster*.

All entries in the *MACHINE PARAMETERS* dialog box are sent to the circuit board plotter when you click on OK and saves to the initialization file when you exit *BoardMaster*. This means that they will be available the next time you start the program.

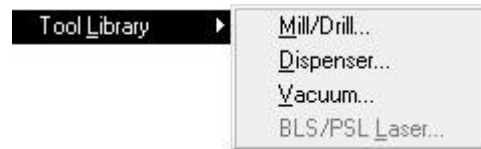
**Further parameters**

UNIT	Clicking on one of these two radio buttons selects inch or metric display for the length, diameter, coordinates information, etc.
TYPE	This text box displays the circuit board plotter type that will be displayed in the <i>BoardMaster</i> title bar. This data is for information only and is of no significance for operation.
NUMBER OF TOOL HOLDERS	<p>The number in this box indicates the number of tool change positions.</p> <p>This is always 1 for the LPKF 91, 92, ProtoMat® 91s, ProtoMat® 92s, ProtoMat® 93s, 101 LC, 101 LC/VS and 101 HI-P circuit board plotters, always 7 for the LPKF Automill and always 30 for ProtoMat® 95s circuit board plotters.</p>
	<p>Clicking on this button sends the command, typed in the text box to the left of the button, to the circuit board plotter.</p> <p>It is not necessary first to click on the  button for this function. Please consult the circuit board plotter manual for the command syntax.</p>
ROTATION SPEED	The number in this box specifies the maximum speed of the circuit board plotter spindle.
MOVING SPEED	The number in this box specifies the maximum travel speed of the circuit board plotter spindle. This has higher priority than the tool speed (see TOOL PARAMETERS dialog box).
RESOLUTION	The numbers in these two text boxes define the distance traversed by the circuit board plotter for one step of the stepper motor in the X or Y direction. These values should never be changed, as otherwise it is no longer possible to guarantee proper scaling of the output.

## Tool parameters

The *BoardMaster* includes tool libraries listing the tools supplied by LPKF with all the tool-specific parameters. The tool library files come in three variants: \*.TOL for drilling and milling tools, \*.DIS for metering needles and \*.VAC for suction needles (only used with LPKF AutoContac). You can modify any list and save it for later use.

The TOOL LIBRARY sub menu of the CONFIGURATION menu gives you access to the various tool libraries:




Select the DRILLING/MILLING HEAD line from the TOOL LIBRARY sub menu of the CONFIGURATION menu to open the following dialog box:

A screenshot of a dialog box titled 'Mill/Drill Tool Edit'. It has a list box on the left containing various tool names, with 'Contour Router 1.0 mm long' selected. To the right of the list box are several buttons: 'New...', 'Delete', 'Replace...', 'OK', 'Cancel', 'Load...', and 'Save...'. Below the buttons are three input fields: 'Diameter [mm]: 1', 'Drill time [sec]: 0', and 'Description: ContourRouter 1.0 mm'. There are also two radio buttons, 'Mill' (selected) and 'Drill'. At the bottom right, there are two more input fields: 'Rotation[1/min]: 40000' and 'Milling[mm/s]: 5'. The dialog box has a standard Windows-style title bar and window controls.

The tool library defines all the tools required for the operation of the circuit board plotter with their characteristic features. The various parameters are described here to assist you in modifying or inserting additional tools.

NAME	The name of the tool is entered in this text box. The name you choose should give some information about the type of tool to make it easier to make a selection in other parts of the program. Selecting a tool from this list box allows you to display and, where necessary, modify its parameters.
DIAMETER	The number in this text box specifies the diameter of the tool. This information allows the system to display the actual diameter of the tool in the graphical workspace and will be used for the automatic tool assignment as well.
DRILLING TIME	The number in this text box indicates the time interval in seconds between "Head down" and "Head up" commands for the drilling tool.
MILL/DRILL	Clicking on one of these two radio buttons defines the tool as a milling tool or drilling tool.

DESCRIPTION	This text box is provided for an additional description of the tool. This information is of no significance for the production process.
SERVICE LIFE	<p>The number in the MAXIMUM text box specifies the maximum milling distance or the maximum number of drillings for the tool.</p> <p>The CURRENT text box displays the distance already milled by the tool or the current number of drillings made by the tool.</p> <p>Clicking on  starts the tool change procedure and resets the content of the CURRENT text box to 0 once the old tool has been replaced.</p>
OPTIMUM SPEED	<p>The number in the SPEED text box specifies the optimum speed of the drilling spindle.</p> <p>The number in the ADVANCE text box defines the optimum rate of advance for milling tools.</p>

**Note:** The speed of rotation is only used automatically for the LPKF ProtoMat® 91s/VS, ProtoMat® 93s, ProtoMat® 95s and *Automill*. In the case of all other circuit board plotters with variable motor speed, the optimum speed of rotation must be set manually on the controller. The optimum speed of rotation to be set is, however, indicated by *BoardMaster* on a tool change.

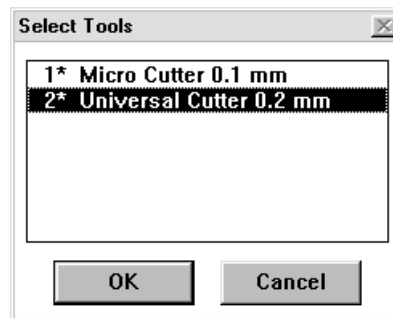
All changing of the tool library could be saved in the tool library file (\*.TOL) for later reuse. The file which is loaded with the start of *BoardMaster* is specified in the *#include* section of the \*.MCH file. Also the valid production phase file and the dispenser and vacuum tool files are specified there.

**Tips & tricks:** By press the *Save* button, all changings will be saved in the current tool library file (\*.TOL).  
By press the *Load* button, you can load other tool libraries.

**Dispenser, vacuum:** These new dialog boxes contain all the important parameter required for dispensing and removing the conductive paste for the AutoContac system. These processes are explained in more detail for their users below in this manual.

**Select:** The Select dialog box is used to select specific tools for a production phase, in order to restrict the operations to these tools.

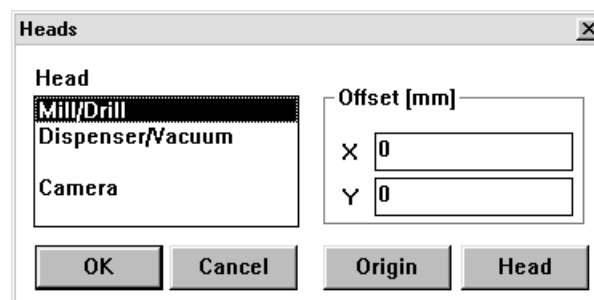
If the PHASE combo box shows a processing phase that is a component of the current job, it is possible to bring up the Selected tools dialog box by clicking on SELECT in the TOOLS menu. Here it is possible to select individual tools for this phase for editing. The default selection is all tools for the phase. Tools that are not selected are ignored. The selection of specific tools can be combined with the selection of a portion of the production data (graphical selection of specific areas on the circuit board or marking of specific vector indices in the data). *BoardMaster* implements a logical AND combination between the data selected and the tools selected.



**Example:** A blunt drill has been used for drilling. Only the drillings made with this tool will be processed if you select this tool and click All+ and Start.  
Or:  
The conductive paste dispensed by the Autocontac should not remain on the circuit board more than about 20 minutes before suction removal is applied to the drillings. You can process very complex printed boards step-by-step if you select the individual needles: Selection 1st Needle diameter, Dispense, Suction, Selection 2nd Needle diameter, Dispense, Suction.....

## The Heads dialog box

The HEADS dialog box is accessed by clicking on HEADS in the CONFIGURATION menu.



The various tool heads are listed on the left-hand side, and the offsets assigned to the highlighted head are shown in the right-hand side:

**DRILLING/MILLING HEAD:** The drilling/milling plotter head used as a reference for all further options fitted to the head. Its offset must, therefore, always be set to X = 0 and Y = 0.

**DISPENSER AND VACUUM:** The distance between the Dispenser/Vacuum needles ( LPKF AutoContac) and the plotter head is defined here. The X and Y values for Dispenser and Vacuum are identical.

The *Special functions for LPKF AutoContac* chapter contains a detailed description of how these offsets are determined.



**CAMERA/LIGHT:** The distance between a light or camera option and the plotter head is defined in these boxes. These can be used for precise positioning when reworking prefabricated circuit boards.

The *Reworking ....* chapter contains a detailed description of how these offsets are determined.

### ***X offset, Y offset:***

These values specify the distance between the metering needles and the drill in the X and Y directions. These values differ for the various types of cartridge toolholders and are in the range of 32 to 35 mm for X and 30 to 37 mm for Y.

Once the offsets have been determined, they should only be corrected if the needles are not positioned exactly centered over the drillings in the circuit board for dispensing or suction. An increase in the *value* corresponds to a displacement of the needle relative to the drilling in the positive X or Y direction.

**Important:** The maximum X and Y coordinates for the working area of the table when dispensing are *smaller* than those for drills and milling heads by these amounts. The restricted workspace will be indicated by a white frame if a dispensing tool or suction tool is selected.

**Tips & tricks:** You can use this white frame to correctly place a project with dispensing and vacuum phases correctly on the printed board. Do this by selecting a dispensing and suction tool in the TOOL combo box (toolbar top left). The white frame will then be visible.

### ***New determination of the offsets***

**CAUTION:** Make sure that no-one can access the circuit board plotter's working area while you are redetermining the offsets. Entering the following commands has an immediate consequence on the circuit board plotter.

The procedures for re-specifying these offsets are as follows:

1. Select the **SPIRAL DRILL 0.5 MM** tool from the TOOL combo box.
2. Insert a 0.5 mm drill.
3. Manually position the plotter head over the circuit board (using the arrow keys or the mouse).
4. Switch on the motor and drill a hole using the Down button.
5. Change to the HEADS dialog box, select **DISPENSER** and click on REFERENCE POINT.
6. Now select the **D PINK CARTRIDGE 0.5 MM** tool, take the drill out and insert a cartridge with a needle (pink) in the holder.
7. Manually (using the arrow keys) shift the needle as precisely as possible over the drill hole in the circuit board (set a step pitch of 0.05 in the MACHINE PARAMETERS dialog box to do this).
8. Press the head down by hand and visually check the position of the needle in the X and Y direction, correcting as appropriate. You will have to use manual control through the arrow keys to do this (see page 36).

9. Change back to the HEADS dialog box, select **DISPENSER** and click on HEADS.

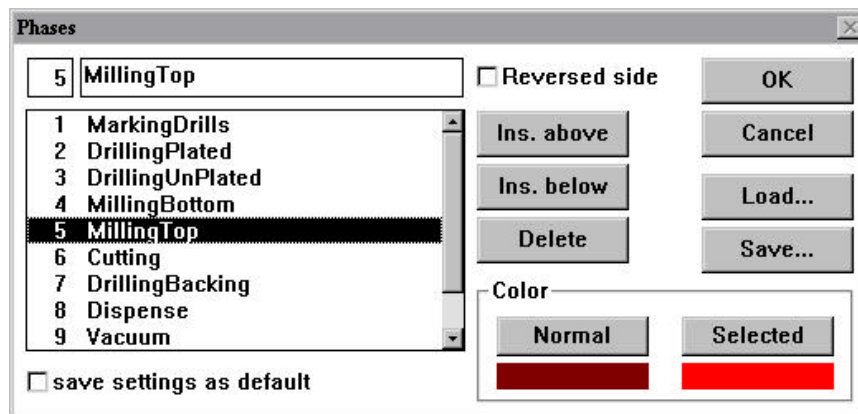
The offsets will be computed by *BoardMaster* and entered. These values should also be used for the VACUUM head. When you exit *BoardMaster*, these values will be saved to the INI file and loaded again the next time you start the program.

## Production phases

All the data to be sent by *BoardMaster* to the circuit board plotter must be assigned to a specific production phase. These production phases embrace an operation in which the user does not need to intervene. An intervention might be, for instance, through-hole plating of the circuit board or turning the board material over. The sole exception to this rule is a manual tool change. This assignment is prepared in *CircuitCAM* and is automatically implemented in *BoardMaster*.

Some production phases are already defined in the initialization file. You can, however, modify these production phases to meet your requirements at any time. The names for the production phases must be the same in *CircuitCAM* and *BoardMaster*.

Open the CONFIGURATION menu and select the PHASES... line to open the following dialog box:



All production phases defined by default are listed in the list box. Selecting a production phase allows you to display and, where necessary, modify its parameters.

Two settings are required for each production phase:

- The color to be used to display the data assigned to this production phase. This setting is used to distinguish the various production phases in the workspace.
- Definition of a production phase as “Standard” or “Reversed side”. Check the REVERSED SIDE check box for all production phases that act on the solder side of the circuit board. All other production phases for which the REVERSED SIDE check box is not marked are thus defined as acting on the component side.

### ***How to create a new production phase:***

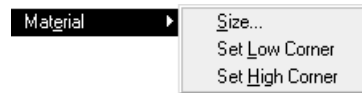
1. Select the production phase before or after which you wish to insert the new production phase.
2. Enter the name for the production phase in the text box.
3. Click on Insert above or Insert below to insert the production phase at the appropriate point in the list box.

**Tips & tricks:** Press **Save** to save all changes to the current phases file (\*.PHS). To load other phases files press **Load**.

## Board material size

The first task in preparing a new job is to define the size of the board material to be used. This is necessary to ensure that the available area for operations is displayed in the workspace, thus permitting the optimum placement of the circuit board data.

The board size is defined in the MATERIAL sub menu of the CONFIGURATION menu:

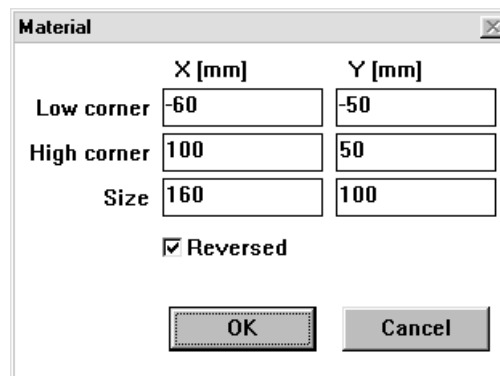


This sub menu offers two options for the definition of board size:

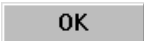
1. Manual input in the SIZE dialog box
2. Determine the size by allowing the circuit board plotter to travel

### *Manual input in the SIZE dialog box*

Open the MATERIAL sub menu of the CONFIGURATION menu and select the SIZE... line to open the following dialog box:

A screenshot of a dialog box titled 'Material'. It contains three rows of input fields: 'Low corner' with values '-60' and '-50', 'High corner' with values '100' and '50', and 'Size' with values '160' and '100'. The columns are labeled 'X [mm]' and 'Y [mm]'. Below the input fields is a checkbox labeled 'Reversed' which is checked. At the bottom are 'OK' and 'Cancel' buttons.

The size of the board material is specified by manually entering the appropriate values in the text boxes. The size calculated from the values entered in the two top text boxes is displayed in the SIZE text box.

The area of the board material will be displayed light grey in the workspace once you quit the dialog box by clicking on .

**Tips & tricks:** Make sure that the minimum values (with a negative sign if necessary) are entered under X MIN / Y MIN and the maximum values are entered under X MAX / Y MAX.

You should only use this option for specifying the size when preparing a job without the circuit board plotter connected, as it is not possible to specify this precisely taking into account the positioning on the circuit board plotter and the location of the registration drillings in the board material.

### ***Determine the size by allowing the circuit board plotter to travel***

The board size is determined precisely when the circuit board plotter is head is moved to use the SET X,Y MIN and SET X,Y MAX functions found in the MATERIAL sub menu of the CONFIGURATION menu.

#### **Caution**









**The following instruction starts the circuit board plotter.**

**Make sure that no-one can access the working area of the circuit board plotter.**

**You must also follow the safety instructions given in the manual for the circuit board plotter .**

#### **Tips & tricks:**

Manual control of the circuit board plotter is required for this process. Consult the “Manual control of the circuit board plotter” section for information on this procedure.

1. Move the plotter head to the “front, right corner” (X/Y min) of the circuit board plotter using the     arrow keys.
2. Select the SET X,Y MIN *line from the* MATERIAL submenu of the CONFIGURATION menu.
3. Move the plotter head of the circuit board plotter to the “rear, left corner” (X/Y max) of the plotter using the     arrow keys.
4. Select the SET X,Y MAX *line from the* MATERIAL submenu of the CONFIGURATION menu.

Once you have specified the board size, the board area will be shown in light grey in the *BoardMaster* workspace.

#### **Tips & tricks:**

Make sure that the controller (standard controller) of the series 101 circuit board plotter is switched to *Select* when you are setting the two coordinates.

Make sure that you follow the specified sequence in setting the coordinates (first front, right corner, then rear, left corner).

Take the fastening strips and the size of the working depth limiter into account when specifying the board size.

Any board size already defined will be deleted when you define a new job (see following section).

## The Go TO menu

This menu contains functions for moving the plotter head to the positions listed:



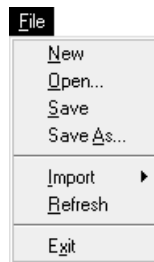
**CAUTION:** Selecting an entry from the GO TO menu causes the circuit board plotter connected to move.

**Make sure that no-one can access the working area of the circuit board plotter or come into contact with the tools while the operations controlled by BoardMaster are being executed.**

HOME	Select this line to move the plotter head to the HOME position (machine origin).
PAUSE	Select this line to move the plotter head to the PAUSE position (by default, this is Xmax/Ymax).
TOOL CHANGE POSITION	Select this line to move the plotter head to the Tool change position (by default, this is Xmin/Ymin).

# The FILE menu

The functions in this menu are used in handling jobs and projects in *BoardMaster*.

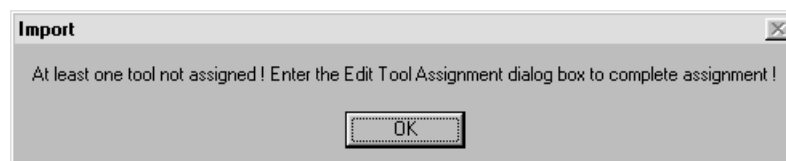


NEW	Select this line to create a new job in <i>BoardMaster</i> .
OPEN	Select this line to open an existing job in <i>BoardMaster</i> . Also Job files from <i>BoardMaster</i> 2.x can be loaded, but the tool assignment has to be done again, because the tool names are different in this version.
SAVE	Select this line to save the job opened in <i>BoardMaster</i> under the filename shown in the <i>BoardMaster</i> title bar.
SAVE AS...	Select this line to save the job opened in <i>BoardMaster</i> under a new filename.
IMPORT	This sub menu contains functions for importing production data or projects into <i>BoardMaster</i> .



LMD OR LPR...	Select this line to import LMD files ( <i>CircuitCAM</i> production data) or LPR files ( <i>BoardMaster</i> HP-GL projects) into <i>BoardMaster</i> . Also Job files from <i>BoardMaster</i> 2.x can be loaded, but the tool assignment has to be done again, because the tool names are different in this version.
HP-GL TO	Select the
NEW LPR...	line from this submenu to import HP-GL files into <i>BoardMaster</i> and to assign them to a new project.
<DEFAULT>	line from this submenu to import HP-GL files into <i>BoardMaster</i> and assign them to the <i>Default</i> project.

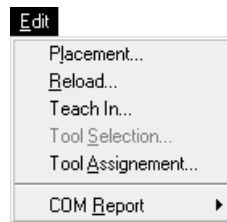
The data are immediately placed in the middle of the circuit board plotter workspace when LMD files are imported. Furthermore, the production phases and tools required are automatically assigned to the data. If *BoardMaster* is unable to assign one or more tools, the following message box will appear:



You will then have to assign the tools manually in the tool assignment dialog box or add to the tool library before importing the data again.

All the tools required will be listed in the *CircuitCAM* report window after the data are exported.

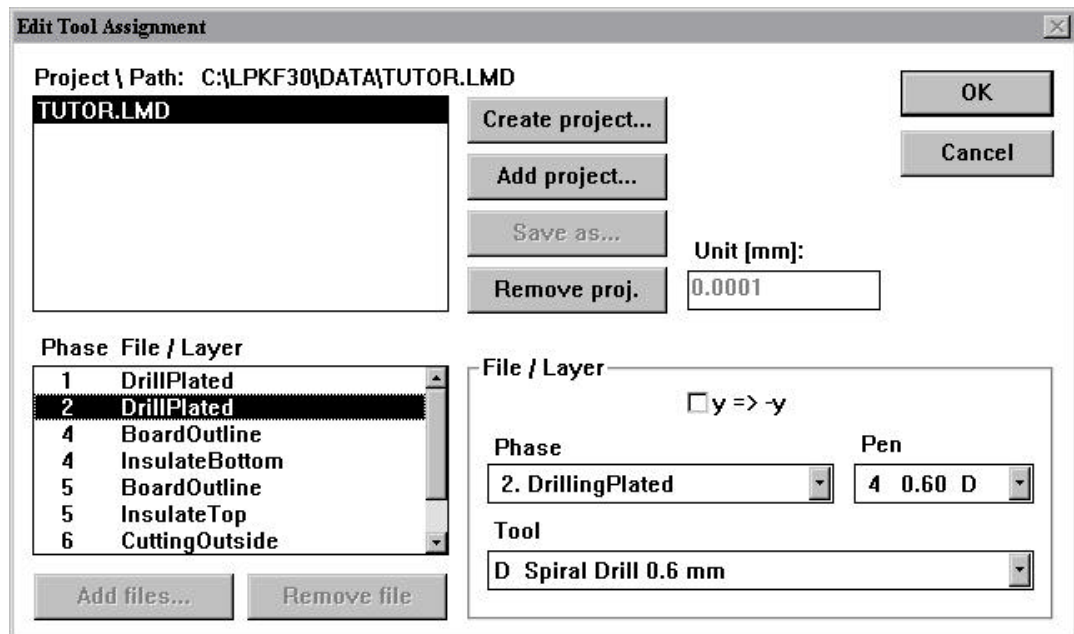
## The EDIT menu



### Tool assignment

Every job in *BoardMaster* is composed of one or more projects. A circuit board imported here as an LMD file or HP-GL project is known as a project.

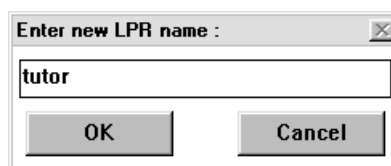
Open the EDIT menu and select the TOOL ASSIGNMENT line to open the following dialog box:



The production data are generally imported using the import function from the file menu. These projects can, however, also be added (LMD file from *CircuitCAM*) or generated (HP-GL files) at this point.

#### How to create a new project:

1. Click on **New project...** to create a new project.
2. Assign a name to the project in the ENTER NEW LPR NAME dialog box:



3. Click on **OK** to close the dialog box.

4. Enter the resolution of the HP-GL files associated with the project in the UNIT text box.

---

**Tips & tricks:** HP-GL files have a default resolution of 0.025 mm. Please change the setting for the HP-GL unit in the Machine parameters dialog box if you wish to use data with a different resolution.


---

5. Click on  to add the selected HP-GL files to your project.

---


**Tips & tricks:** All the HP-GL files for a project must be located in the same folder.

You can remove HP-GL files from a project again by selecting the appropriate entry in the PHASE FILE/LAYER list box and clicking on

.

6. You must further also assign the following information under FILE/LAYER to any file containing production data:

PHASE	Select the phase to which the production data are to be assigned from this list box.
PEN/TOOL	Select from the PEN list box the pen from the HP-GL file to which the tool selected in the TOOL list box is to be assigned.
Y=>-Y	Enable this check box to allow simultaneous coincident display of both sides of the circuit board for the case of production data created as mirror images. (Generally the solder side in all production data.)

7. Click on  to save the project as an LPR file.

---

**Tips & tricks:** To allow you to open a project saved as an LPR file again when you start the *BoardMaster* program, you should select LMD OR LPR... line of the IMPORT sub menu of the FILE menu.

Or:

Click on  to add a project.

This project may be an LMD file generated by *CircuitCAM* or an LPR file (HP-GL project file) generated in *BoardMaster*.

---



## Placing projects

Once you have imported or generated the projects you require, you will be able to place them in the *BoardMaster* workspace. Imported projects are automatically placed in the centre of the workspace.

Open the Edit menu and select the PLACEMENT ... line to open the following dialog box:

### How to place a project:

1. Select the project you wish to place from the list box.
2. Enter the scaling you require for the project in the SCALE text box.

**Tips & tricks:** The default value for the scale is 1, i.e. a 1:1 scale. You may, however, also specify a different scale here for applications such as engraving front panels and plates.

3. Enter the position required for the project in the workspace into the X and Y text boxes under ORIGIN. These values relate to the *HOME* position for the circuit board plotter.

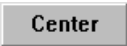
**Tips & tricks:** You may enter the values 0 and 0 here if the precise position of the data in the coordinates system is not known, and place the project in the workspace using the toolbar or mouse.

4. Select the alignment of the project in the workspace under ROTATION.
5. Specify the number of multiple uses under COUNT.  
Enter the number of uses in the X direction in the first text box and the number of uses in the Y direction in the second text box.
6. Specify the spacing between the uses under DISPLACEMENT.  
Enter the spacing between uses in the X direction in the first text box and the spacing between uses in the Y direction in the second text box.


**Tips & tricks:** The spacing between uses must be at least as great as the circuit board width or length, respectively, as otherwise the uses would overlap.

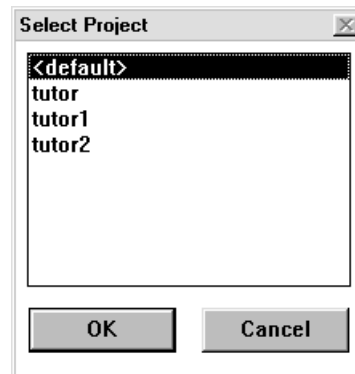
Multiple uses can also be created using the toolbar.

***How to place a project centred on the board material:***

1. Select the appropriate project from the list box.
2. Click on  to place the project selected centrally on the board material.


***How to add further projects for placement:***

1. Click on .
2. Select the project you also wish to place on the board material from the list box:



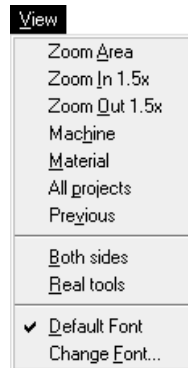
3. Click on  to close the dialog box.


***How to remove a project that has already been placed:***

1. Select the appropriate project from the list box.
2. Click on  to remove the project from the board material again.

## The VIEW menu

You can customize the graphical representation of the *BoardMaster* workspace to your requirements using the VIEW menu functions.

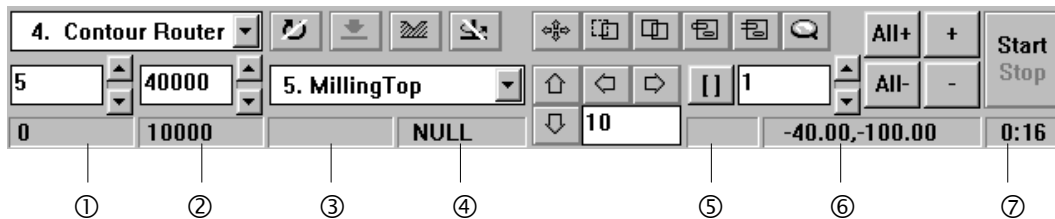


ZOOM AREA	Select this function to have any detail of the workspace zoomed to full screen display. Do this by clicking the left mouse button and holding it down while you cover the area required. You can also select this function by clicking on  in the toolbar.
ENLARGE X1.5	Select this function to enlarge the graphical representation by a factor of 1.5.
REDUCE /1.5	Select this function to reduce the graphical representation by a factor of 1.5.
MACHINE	Select this function to display the full working area of the circuit board plotter configured in the workspace.
MATERIAL	Select this function to display the full board material area in the workspace.
ALL PROJECTS	Select this function to display all the placed projects as large as possible in the workspace.
PREVIOUS	Select this function to display the last previous screen detail again.
BOTH SIDES	Select this function to toggle between simultaneous display of both sides of a circuit board and display of one side of the circuit board only.
TRUE WIDTH	Select this function to switch on or off display of the milling lines in their true width. The true width of the milling lines is defined in the tool library.
DEFAULT FONT	Select this function to toggle between the Windows system font and the font specified under DIFFERENT FONT for text display.
CHANGE FONT...	Select this function to select the font to be displayed if the DEFAULT FONT option is disabled.

# The Toolbar

The toolbar in *BoardMaster* contains functions for placing and copying projects on the board material and for controlling the connected circuit board plotter. In addition, the toolbar shows important status information relating to the current machining process.

## Status information



### ① Current service wear

The value displayed here indicates the distance milled or the number of drillings already completed by the current tool.

The value displayed here is identical with the value displayed in the CURRENT text box of the DRILLING AND MILLING TOOL PARAMETERS dialog box.

### ② Maximum service life

The value displayed here indicates the distance that can be milled or the number of drillings that can be completed by the current tool.

The value displayed here is identical with the value displayed in the MAXIMUM text box of the DRILLING AND MILLING TOOL PARAMETERS dialog box.

### ③ Distance in the current production phase

The value displayed here indicates the milling distance or the number of drillings already completed in the current production phase by the current tool.

### ④ Communication port

This field indicates the interface to which the control data are being sent. NULL here means that the data are not being sent to any interface. If you move the mouse pointer over this display panel, the parameters set for the interface will be displayed in the status bar.

### ⑤ Data marked/selected

This field indicates whether a section of the production phase data has been

Marked **(P)**

Selected **(F)** or

Partially marked/partially selected **(P/F)**.

### ⑥ Current plotter head position

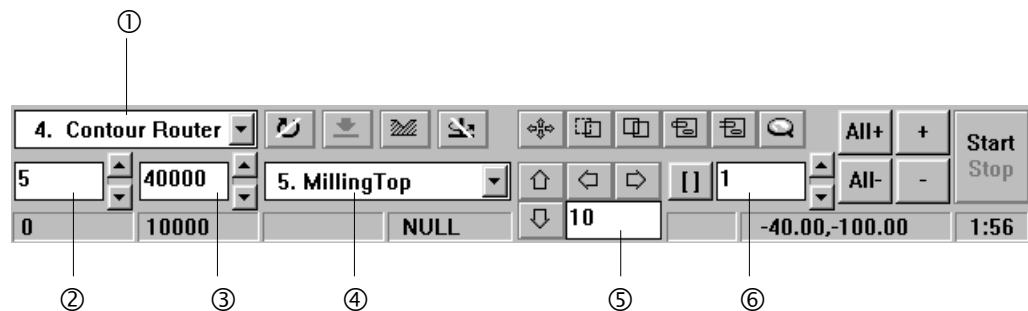
This panel indicates the current position of the plotter head.

### ⑦ Estimated processing time for the current production phase

This panel indicates the estimated time in hours:minutes required to process the complete production phase. Isolated selections are ignored here.

## Variable parameters

You may edit, and thus customize to your requirements, the message areas listed here.



### ① Tool

This list box shows the tool being used for the current production phase.

### ② Milling speed/drilling time

The value displayed here indicates the milling speed or the drilling time defined in the tool library for the tool displayed in ①.

You can increase or reduce this value by clicking on the arrow buttons to the right of the field or type a specific value.

### ③ Speed of rotation

The value displayed here indicates the speed of rotation defined in the tool library for the tool indicated in ①.

You can increase or reduce this value by clicking on the arrow buttons to the right of the field or type a specific value.

### ④ Current production phase

This list box displays the current production phase.

### ⑤ Step pitch for manual control

This text box defines the step pitch by which the plotter head is moved on a click of one of the four arrow keys. You may highlight the text box and increase or reduce the value in fixed increments using the + or - key or type a specific value.

### ⑥ Vector index

Specify the vector index in this text box. An index is incremented for every line section, arc or drilling. Here you may specify, for instance, from which vector index machining should be started or the range of vectors to be done.

# Placement functions

---

**Tips & tricks:** Open the EDIT menu and select PLACEMENT... to bring up the PLACEMENT dialog box to help you accurately place the projects at their approximate position on the board material.  
Use the following functions on the toolbar in a second step to place the projects visually.

---



## **Duplicate project**

Check this button to move a project around the board material.  
Place the mouse pointer over the project to be moved, click the left mouse button and drag the project to the desired position holding the mouse button down.

The project is displayed as a light area while it is being moved.



## **Duplicate project**

Check this button to duplicate a project and to place the copy (multiple use) on the board material.

Place the mouse pointer over the project to be duplicated, click the left mouse button and drag the copy of the project to the desired position holding the mouse button down.

The copy of the project is displayed as a light area while it is being duplicated.

---

**Tips & tricks:** You must click the appropriate button again each time you wish to move or duplicate a project.

Press the **<ESC>** key to cancel a function.

Click the right mouse button on a project to open the PLACEMENT dialog box and display the parameters for this project.

You can, for instance correct the reference point values in this dialog box to place the projects on the same X or Y coordinate (in register), for instance. This may be useful if you wish to use a guillotine or saw for later dividing up a multiple use board.

You may also use the PLACEMENT dialog box to rotate a project – after placement with the mouse – by changing the ROTATE parameter.

---

## Control functions for manual control

**CAUTION:** The connected circuit board plotter will be set in motion when one of the following buttons in the toolbar is selected.

**Make sure that no-one can access the working area of the circuit board plotter or come into contact with the tools while the operations controlled by BoardMaster are being executed.**

Most of the functions found on the front panel of the controllers of devices with *MCU* controllers are also found in the toolbar. This means that these functions can be executed through *BoardMaster*. The precondition for this is that the controller is switched to “on line”, the *Select* LED must light up (not on devices with *SMCU* controllers: LPKF 91s, LPKF 92s, ProtoMat® 91s, ProtoMat® 91s/VS, ProtoMat® 92s, ProtoMat® 93s, ProtoMat® 95s).



### Manual control

The plotter head can be moved in the +X, +Y, -X and -Y directions using the arrow keys. Pressing one of the arrow keys once moves the head in the direction selected by the amount specified in the STEP PITCH FOR MANUAL CONTROL field in the toolbar.

(See “Variable parameters”, page 35.)

Movement less than 45° is only possible on MCU controllers using the movement buttons on the controller.

The arrow keys specify the direction in the coordinates system, whatever the alignment of the circuit board plotter with regard to the monitor.



### Movement using the mouse

When this button is clicked, the plotter head will move to the position in the workspace on which you click with the left mouse button.

If you hold the left mouse button down, you can move the mouse and the plotter head will follow the mouse movement once it has arrived at the mouse's starting position.

This function can be used to move the plotter head very quickly to any position, for example, to define the board size or to drill or mill manually on the board material.

The button must be clicked again if the plotter head is to be controlled by the mouse movement again.



#### **Milling/drilling motor on/off**

This button switches the milling/drilling motor on or off.  
The appropriate button will be displayed according to the status.  
The milling/drilling motor is switched off automatically when you exit *BoardMaster*.



#### **Raise/lower plotter head**

This button raises and lowers the plotter head.  
The appropriate button will be displayed according to the status.  
The plotter head can only be lowered if the milling/drilling motor is switched on.  
The plotter head is automatically raised when a milling or drilling procedure is terminated.



#### **Milling/drilling mode**

You may use this button to toggle the controller mode between milling and drilling.  
The appropriate button will be displayed according to the status.  
The advance rate of the milling tool or the drilling time of the drilling tool will then be observed, depending on the mode activated.  
A milling file will not be processed in drilling mode and, inversely, a drilling file will not be processed in milling mode. The mode will be set automatically with every tool change.



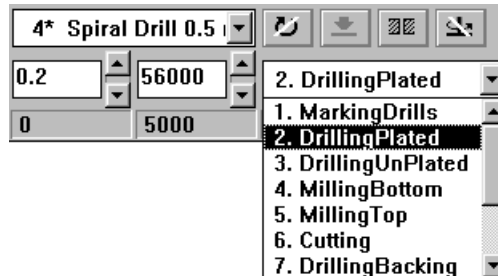
#### **Automotor on/off**

You may use this button to enable or disable automatic control for switching the motor on and off.  
The appropriate button will be displayed according to the status.  
When the Automotor function is enabled the milling/drilling motor will be switched on at the start of a production phase and switched off again when the phase is completed. The same is true for tool change on circuit board plotters with manual tool change.  
This function has a higher priority than the **Motor on/off** and **Raise/lower plotter head** functions. These two functions are disabled if Automotor is enabled.



## Select production phase

You must first select the production phase to be processed next before the milling or drilling data can be sent to the circuit board plotter. This selection is made in the PRODUCTION PHASE list box of the toolbar:



Highlight the production phase to be processed next. Make sure that the production phase you highlight that has also been assigned to an HP-GL file or the LMD file. An incorrect selection will either cause the incorrect files to be processed, or cause no data at all to be sent.

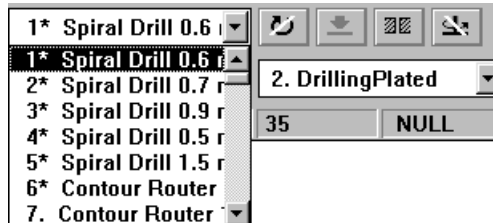
Below we show an example of the sequence of production phases for a double-sided circuit board:

1. Drilling
2. Milling the solder side
3. Milling the component side
4. Milling the contours

# Tool change

## Circuit board plotters with manual tool change

The TOOL list box in the toolbar lists all the tools in the tool library. This list is sorted, first shown the tools being used within the current production phase (marked with a “\*”):



**Tips & Tricks** The first production phase will be active if no particular production phase has been selected.

If a different tool is selected from the list, the plotter head will be moved to the tool change position and the controller on devices with *MCU* controllers will be switched to *Deselect*. At the same time, a message appears on screen stating that the tool just selected must be changed for the current tool.

**CAUTION:** This selection operates the Circuit Board Plotter automatically. You must also follow the safety instructions relating to tool changes given in the manual for the circuit board plotter.

Once you have changed the tool, switched the *MCU* controller back to *Select*, and confirmed the change by clicking on , the system can continue with further control commands.

## Circuit board plotters with automatic tool change

Automatic tool change is only possible if you have installed *BoardMaster* for the ProtoMat® 95s or the LPKF 101 Automill. If you now open the TOOL list box in the toolbar, you will not see a list of all tools, as is the case with circuit board plotters with manual tool change, but rather only a list of the thirty or seven tool positions with the relevant tool assignment.

**Note:** The <UNKNOWN> tool is assigned to each tool position each time the program is started, ie no tool is entered. This is intended to force the user to check the tools in the circuit board plotter's magazines and to assign the corresponding positions in the TOOL POSITIONS dialog box.

Open the TOOL POSITIONS dialog box by clicking with right mouse button on the TOOL list box:

Pos.	Tool	Select	Curr.[mm]	Max.[mm]	Wanted for current phase
1.	*Contour Router 2.0	<input checked="" type="radio"/>	0	8000	35 Spiral Drill 0.6 mm
2.	*Spiral Drill 0.5 mm	<input type="radio"/>	0	5000	63 Spiral Drill 0.7 mm
3.	*Spiral Drill 0.6 mm	<input type="radio"/>	0	5000	546 Spiral Drill 0.9 mm
4.	*Spiral Drill 0.7 mm	<input type="radio"/>	0	5000	596 Spiral Drill 0.5 mm
5.	*Spiral Drill 0.9 mm	<input type="radio"/>	0	4000	16 Spiral Drill 1.5 mm
6.	*Spiral Drill 1.5 mm	<input type="radio"/>	0	3000	70 Contour Router 2.0 mm lo
7.	< unknown >	<input type="radio"/>			

Tool Box

☐ Up ☐ Down

OK Cancel Pg Up Pg Dn Load list Save list

You assign a tool to tool positions 1 to 30 (7 for the LPKF 101 Automill ) by selecting the tool required for the production phase in the appropriate list box. The current service life CURR. and the maximum service life MAX. is displayed after each tool. The WANTED FOR THE CURRENT PHASE list box lists the tools required for the production phase currently selected. Clicking on the appropriate radio button under SELECT defines which tool is currently located in the plotter head.

**Tips & tricks:** Click on the **Load list** button to load the tool magazine with the same tools as the last time *BoardMaster* was used.

This dialog box will be opened automatically at the start of the production phase if a required tool has not been assigned to a tool position. You will only be able to continue once all tools have been assigned to a position.

# Selection functions

Once the next production phase to be processed has been selected and the tool positions have been occupied (only required for automatic tool change), you will be able to select the data for this production phase to be sent to the circuit board plotter. It is only possible to send selected data for one production phase at a time to the circuit board plotter.

The toolbar includes the following buttons for the selection of data:



## Select all data

Enable this button to select all the data for the current production phase. The selected data are shown lighter color on the screen.



## Cancel selection

Click on this button to cancel the current data selection.



## Mark area

Click on this button to mark a range of data. Do this by clicking the left mouse button and holding it down while you cover the area required. This function also marks all the entire lines that cross the rubber-band selection. The marked data are shown in white on the screen.



## Select area (only inside)

Click on this button to mark a range of data. Do this by clicking the left mouse button and holding it down while you cover the area required. This function only marks lines crossing the rubber-band selection as far as their first point coordinate outside this area. The marked data are shown in white on the screen.

**Tips & tricks:** You must click the appropriate button again each time you wish to select an area.  
Press the **<ESC>** key to cancel a function.



## Add marked data to the selection

Click on this button to add the marked data to the selection.



## Remove marked data from the selection

Click on this button to remove the marked data from the current selection.

## Control functions for the production phase

**CAUTION:** The connected circuit board plotter will be set in motion when the following buttons in the toolbar are selected.

Make sure that no-one can access the working area of the circuit board plotter or come into contact with the tools while the operations controlled by BoardMaster are being executed.

A rectangular button with a light gray background. It contains the word "Start" in bold black text on the top line and the word "Stop" in regular black text on the bottom line.

### Start

Click on this button to send the selected data for the current production phase to the circuit board plotter through the serial interface.

A rectangular button with a light gray background. It contains the word "Start" in bold black text on the top line and the word "Stop" in regular black text on the bottom line.

### Stop

Click on this button to terminate data transmission to the circuit board plotter once started.

**CAUTION:** The circuit board plotter will **NOT** halt **IMMEDIATELY** you click on the **Stop** button, but will first process the data remaining in the buffer memory.

Clicking the **Stop** button only interrupts data transmission to the circuit board plotter.

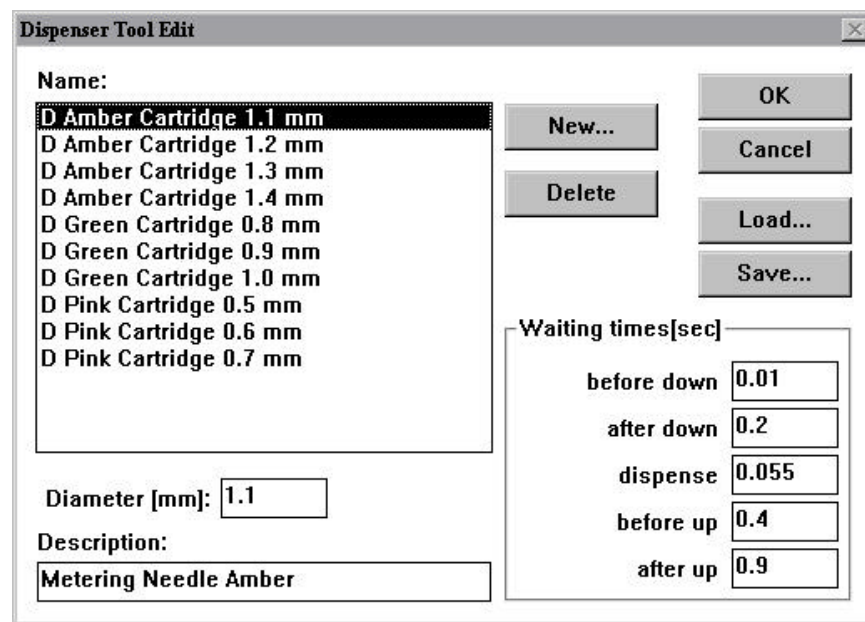


# Special functions

## for LPKF AutoContac

### *Dispenser tool*


The DISPENSER TOOL EDIT dialog box contains a list of the dispenser tools available.




The names for the tools are built up as follows: The abbreviation **D** for dispenser is followed by the colour of the metering needle, then by the associated drilling diameter in mm.

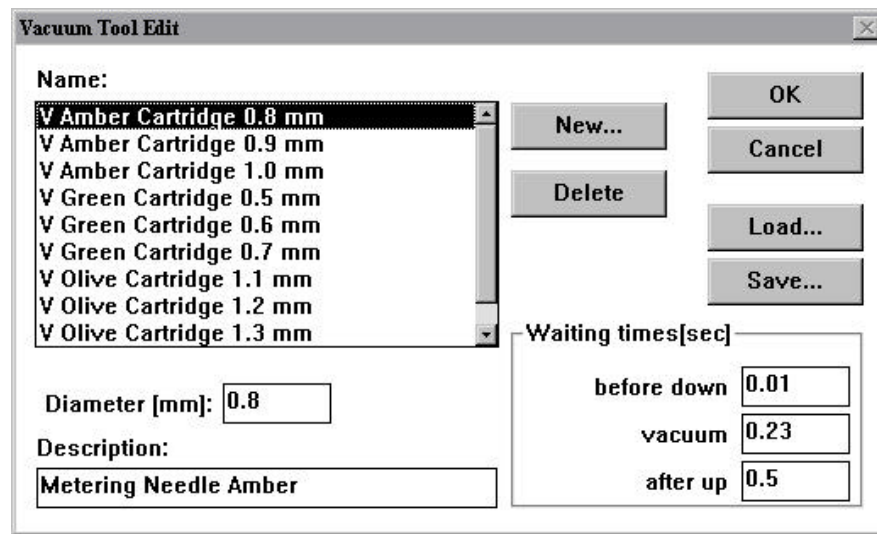
For instance, for a 0.8 mm diameter drilling, you must use the **D GREEN CARTRIDGE 0.8 MM**, ie a green metering needle. It is clear from the list of tools, that the same needle can be used for a number of different drilling diameters. The difference between these tools lies in the different settings for the wait times. See the *Wait times in dispensing* section for an explanation of the meaning of these times.

The user is able to define his own tools (eg for solder paste dispensing) or to modify the settings for the existing tools, thus having a direct influence on their function.


**Tips & tricks:** Press  to save all dispense parameters to the current dispenser library file (\*.DIS).


To load other dispenser libraries press .

The VACUUM TOOL EDIT dialog box contains a list of the suction tools available.



The names of the suction tools are composed of the letter **V** followed by the colour of the metering needle used and finally the associated drilling diameter. See over the page for an explanation of the wait times.

**Tips & tricks:** Press  to save all vacuum parameters to the current vacuum library file (\*.VAC).

To load other vacuum libraries press .

### ***Lift button and Adjustment button***



Clicking the Lift button in the function bar on a milling tool (when the motor is running) causes the head to be lowered.

Clicking the Lift button on a drilling, metering or suction tool causes the execution of a single drilling, metering or suction cycle.



There is a special Adjustment button for the adjustment of metering and suction tools ('A' + arrow). Click on this button to lower the head of a suction tool, and click on it again to lift the tool again. The compressed air will also be switched on or off again for the case of a metering tool.

This function is used to vent a new metering needle.



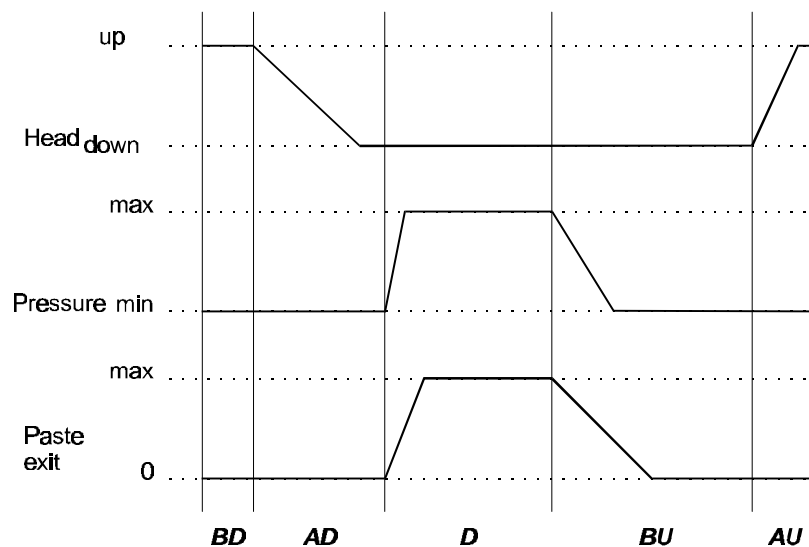
### ***Wait times for dispensing***

All the wait times necessary for the control of the dispense operation are entered in ms (milliseconds) in the WAIT TIMES boxes of the DISPENSER TOOL EDIT dialog box. Different values will be entered here depending on the various diameters of the drill holes and the metering needles to be used.

The significance of the various wait times is described below.

- Before Down (BD)**): The **BD** wait time is added to settle the plotter head before the needle is lowered once it has reached a hole position. This can be very short, in the region of **BD** = 10 ms.
- After Down (AD)**): The **AD** wait time *after the command* lowering the head, takes account of the fact that the needle takes about 180 ms before it is in contact with the circuit board. **AD** can thus be fixed at 200 ms.
- Dispense (D)**): The time **D** between the solenoid valve opening and closing is the duration of the compressed air pulse. This time, together with the pressure selected, determines the volume of solder paste forced into the drill and must be set appropriate for the drill hole diameter and the needle used.
- Before Up (BU)**): The **BU** wait time between the solenoid valve closing and the needle being lifted takes account of the paste continuing to flow following the end of the compressed air pulse as a result of the relatively slow pressure decline in the cartridge. This is intended to ensure that the needle is lifted cleanly from the circuit board and can be set to a fixed value of **BU** = 400 ms.
- After Up (AU)**): The **AU** time is also used to ensure a clean process. There is a problem, particularly with large diameter needles (brown needles) of the paste forming a thread as the needle is raised. The **AU** wait time after the command to raise the needle waits for these threads to break and prevents the tool head moving immediately; this prevents the paste thread being laid across the isolation track. **AU** can be set to shorter times for small needle diameters than for large diameters.

The graph below illustrates the function of the wait times in the dispense operation:



Wait times in the dispense operation

The graph above plots the position of the tool head, the changes in pressure in the cartridge and the exit speed of the paste against process time.

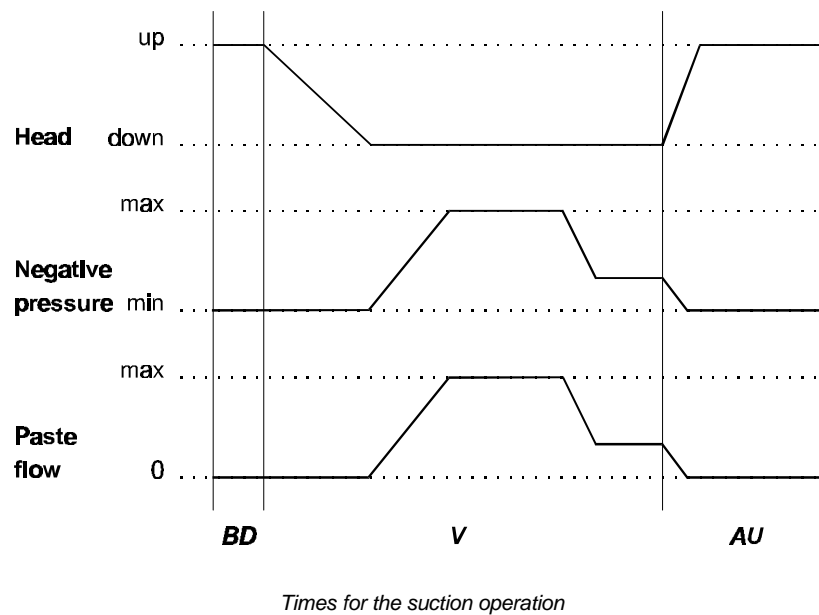
The gradient of the pressure pulse transitions is determined by the buffer effect of the air volume in the hose and the cartridge. The term *min* instead of 0 is intended to indicate that a weak vacuum is also present in the needle during the dispense procedure to prevent dripping. The vacuum is applied to the cartridge once the solenoid valve is closed.

### Wait times for vacuum

All the wait times necessary for the control of the suction operation are entered in ms in the **Wait times** boxes of the **Edit Suction Tool** dialog box.

- Before Down (BD):** This has the same meaning as during the dispense procedure.
- Vacuum (V):** The time **V** between the *commands* for lowering and raising the tool head has an indirect influence on the contact time of the suction needle. A time of around 180 ms for the head to lower needs to be subtracted.
- After Up (AU):** The **AU** wait time gives the paste sucked up time to pass through the needle into the cartridge. This ensures that the needle is free again before the next suction operation. **AU** can be set to a fixed value of 500 ms.

The graph below illustrates the function of the wait times in the suction operation:



The graph above plots the position of the tool head, the negative pressure in the cartridge and the flow rate of the paste *in the drill hole* against process time.

The vacuum level is fixed on the metering device. The maximum negative pressure is established in the cartridge when the needle is closed. The negative pressure in the cartridge falls to a greater or lesser degree, however, as air is sucked through the needle depending on the magnitude of the volume flow. The minimum negative pressure is established once the needle is completely free. This situation exists when the head is **up**.

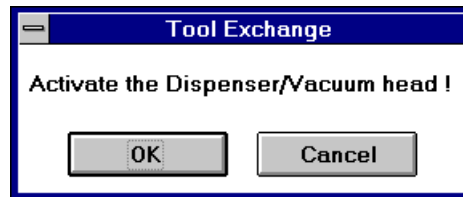
When the suction needle is placed on the paste-filled drill hole, the negative pressure in the cartridge rises to the preset maximum negative pressure. This sucks the paste upwards through the drill hole into the needle. The negative pressure falls again when the drill hole is finally opened and air is sucked through it. The air flow in the drill hole forces the paste further up the hole side wall until the needle lifts and the air flow through the drill hole is halted.

### ***Enable / Disable DispoMat***

If a new tool is required according to the TOOL combo box (at the top left of the toolbar) when a new phase is started or on a manual tool change, *BoardMaster* will first query the position of the toggle switch on the adapter plug.



Switch down means ***Dispenser active***, switch up means ***Dispenser inactive***, i.e. the milling/drilling motor is switched on.

If this dispenser is not correct for the tool selected, the user will be prompted to change the position of the toggle switch. If, for example, the dispenser is disabled, and a dispensing or suction tool is selected, the **ENABLE DISPENSER/SUCTION HEAD** prompt will appear. If, conversely, the dispenser is enabled and a drilling or milling tool is selected, the **DISABLE DISPENSER/SUCTION HEAD** prompt will be displayed.



*Querying the toggle switch*

---

<b>Important:</b>	<p>Please always acknowledge by clicking .</p> <p><i>BoardMaster</i> then checks the position of the toggle switch once again and, if necessary, prompts the user again to set the switch appropriately.</p> <p>Clicking on  implements the tool change without checking whether the dispenser is enabled.</p> <p>The short switching pulses actually intended for controlling the solenoid valve in the metering device are passed to the motor if the metering device is switched on and a dispensing tool has been selected.</p>
-------------------	--

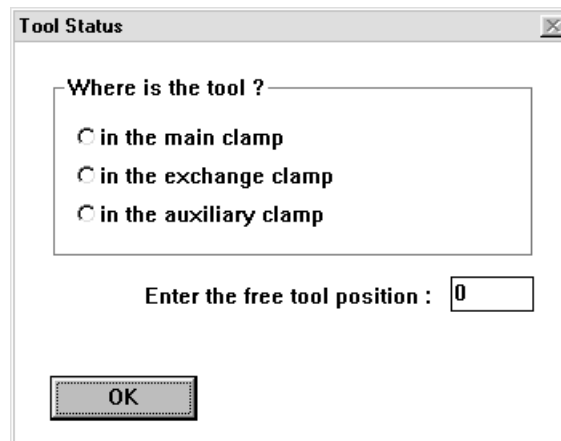
---

## for ProtoMat<sup>®</sup> 95s

### *The Tool Status dialog box*

It is a requirement that the correct switch-on sequence be followed for problem-free operation with the ProtoMat<sup>®</sup> 95s. The circuit board plotter must be switched on and the initialization run completed before *BoardMaster* is started. Otherwise it will not be possible to execute the communication operation that occur as soon as *BoardMaster* is started.

The TOOL STATUS dialog box will appear when the program is started:



Tool Status

Where is the tool ?

☐ in the main clamp

☐ in the exchange clamp

☐ in the auxiliary clamp

Enter the free tool position : 0

OK

**CAUTION:** You must determine if there any tool is present when the machine is switched on. If the tool is located in one of the clamps then you must specify the free tool position in the tool magazine.

**Comment:** Position 1 = tool 1 is on the far right,  
Position 30 = tool 30 is therefore on the far left of the tool magazine.

### ***The Service Password dialog box***

If service is required, clicking on SERVICE in the STATUS... and TOOL MAGAZINE... dialog boxes of the CONFIGURATION menu brings up the following screen prompting you to enter the password.



It is then possible to make changes to the settings in the dialog boxes concerned.

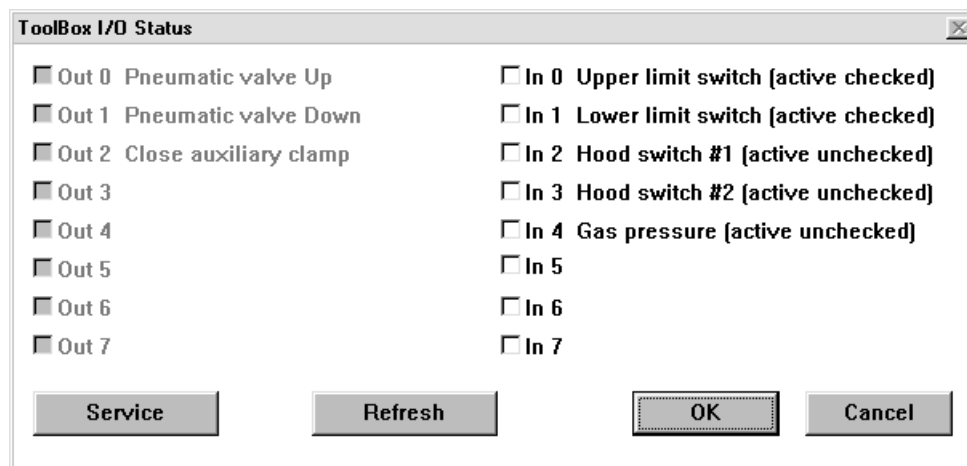
**CAUTION:** These changes may only be made by persons who have been trained in the functioning and operation of the ProtoMat® 95s.

You must observe the proper functioning of the machine and the safety regulations to avoid personal injury and damage to the machine.

Enter the password [ bmaster ] if you are authorized to make changes.

### ***The ToolBox I/O Status dialog box***

Clicking on STATUS... opens the TOOL MAGAZINE I/O STATUS dialog box:



The TOOL MAGAZINE I/O STATUS dialog box shows information regarding the signals set or which data lines are connected.

**In** is used to check the lines that are also connected for tool change, **Out** indicates which lines have been enabled by *BoardMaster*.

The **Refresh** button can be used to check whether any status changes made have been detected and accepted by the system.

### The Tool Magazine dialog box

The TOOL MAGAZINE dialog box is accessed by clicking on TOOL MAGAZINE.... in the CONFIGURATION menu:

Here you can check manually the alignment positions preset by LPKF for automatic tool change. The user does not normally need to make any changes here, as there is no effect on milling and drilling as a consequence of this. The numerical values entered indicate a sample configuration.

MAIN CLAMP AT EXCHANGE POS.

defines the position of the plotter head over the transfer station.

AUXILLARY CLAMP AT EXCHANGE POS.

indicates the position of the gripper over the transfer station.

AUXILLARY CLAMP AT FIRST TOOL POS.

specifies the preset position of the gripper over the first tool in the tool magazine.

AUXILLARY CLAMP AT LAST TOOL POS.

indicates the position defined for the gripper over the last tool.

The **Read** button can be used to change the current position of the plotter head, clicking on **Move** then verifies this change.

These positions, and also HOME and SIZE, are preset in the factory (file BM-95PS.INI).

**CAUTION:** Note that it is possible to overwrite the current positions and thus there is a hazard to the user and damage to the machine is possible.

DELAY

indicates the wait time between the various commands.

HEAD SHIFT IN X DIRECTION

indicates the plotter head travel in the X direction during a tool change.

The status of the three combo boxes, MAIN CLAMP (of the plotter head), EXCHANGE CLAMP and TOOLBOX must correspond to the status when the TOOL MAGAZINE box is opened or otherwise it is not possible to quite the TOOL MAGAZINE box.

**Comment:** The plotter must be switched on and connected before you can quit the TOOL MAGAZINE box.

## The Teach In dialog box

Since version 2.47, *BoardMaster* has offered the function of programming drilling and milling data from a template (film or circuit board) using a Teach In process. This is done by fixing the template in the circuit board plotter and then travelling to the positions you wish to program by this method using a light spot as a guide. After programming, the HP-GL file can be imported into *BoardMaster* and output to the circuit board plotter.

The TEACH IN dialog box is displayed when you select TEACH IN from the MACHINE menu.

- STEP [MM]:** The values entered under **X** and **Y** (in mm) indicate the distance traveled for a single click of the travel buttons (+X, -X, +Y and -Y). A value of 2.54 mm must be entered here when programming the drillings for an IC, this corresponds to a pad spacing of 1/10".
- HEAD:** Clicking on one of these two radio buttons (UP, DOWN) programs the Head Down or Head Up commands. The head will remain in the chosen position until the other radio button is selected. This function is not used for the creation of a drilling file, but for programming milling or contour data.
- RECORD MOVEMENTS:** Enabling this check box causes all movement commands to be recorded in the file selected.
- PEN:** The pen number entered in this box is written to the selected file as a *Select Pen* command. This means that all drilling data, including that for different diameters, can be combined in one drilling file. Example: Pen 1 for 0.7mm, pen 2 for 0.9mm etc.
- +X, -X, +Y, -Y:** These buttons are used to move to a desired position. Clicking on one of these buttons causes the plotter head to move by the amount specified under *Pitch* in the direction selected.
- EXIT:** Clicking on this button closes the TEACH IN module of *BoardMaster* and closes the drilling or milling file being recorded.



- CREATE FILE:** When this button is clicked, *BoardMaster* prompts you to name a file into which the data to be programmed will be saved. Here you may either create a new file or overwrite an existing file.
- APPEND FILE:** Clicking on this button allows you to select an existing drilling or milling file to which the additional drilling or milling data will be appended. The new data will be appended to the end of the file selected.
- PEN [SP]:** Clicking on this button adds the pen or tool number selected under Pen to the drilling or milling file as a *Select Pen (SP)* command. This is used to distinguish between different drilling diameters.
- PLOT [PA]:** This button can be used to move the head at angles other than 90° (with the RECORD MOVEMENTS function deselected).
- DRILL [PD;PU;]:** This button is clicked to program a drilling operation once you have moved to the correct position. This writes the *Pen Down, Pen Up* command sequence to the file. This command sequence corresponds to a drill command for the circuit board plotter.

### Procedure

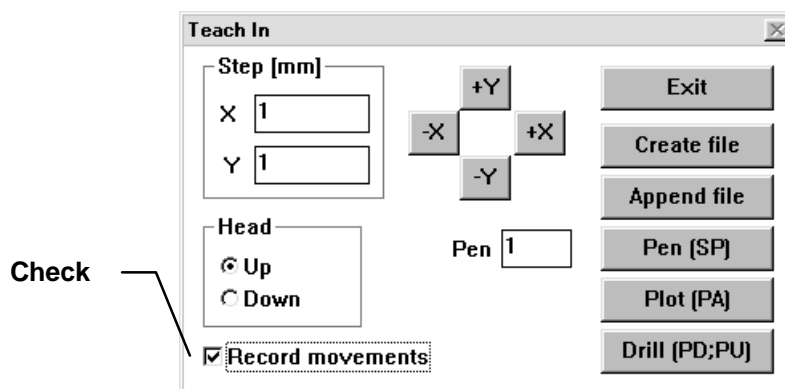
1. Set the unit appropriate for the machine resolution (0.0079375) in the EDIT PROJECT dialog box. (You will also find this value in the PARAMETERS dialog box of the Configuration menu.)

Please do not forget to reset the resolution to the original value when this operation is completed.

2. Now open the TEACH IN dialog box to import the coordinates required.

Note here that a file has already been written for the data to be created; the coordinates will then be imported into this file in sequence. Do this by clicking on the **Append file** button. A new window in which you can assign a name to the file will open. You may use any extension for the file.

3. Once you have entered the name, you will be returned to the TEACH IN dialog box. You must check the RECORD MOVEMENTS option (see figure) before you can begin importing data.



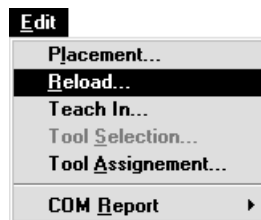
4. The file to be created is an HPGL file which means that it will be written in the structure appropriate for an HPGL file. You should thus first click the **Pen (SP)** button to define a pen.
5. Now move the head to the drill hole position to be imported using the movement buttons and click on the **Drill (PD;PU)** button.

6. Once you have imported all the drilling data required, you should close the TEACH IN dialog box by clicking the **Exit** button.  
The coordinates recorded will now be saved in the HPGL file previously created.
7. If you now wish to produce a board using this newly entered data with *BoardMaster* and the machine, you must open the EDIT PROJECT dialog box.  
It is best first to create a new project by clicking on **New Project**. You may then insert the associated HPGL file using **add....**

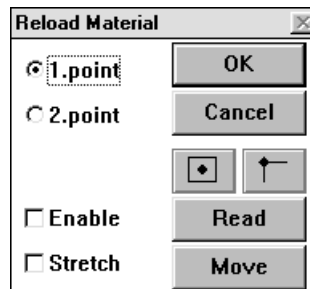
## The Reload Material dialog box

The *Reload* function is used to rework a circuit board which has already been produced and cut to size, for example to add additional drillings, engrave labels or to separate the conductor tracks on circuit boards that have already been produced for coding purposes.

Clicking on EDIT in the menu bar brings up the following menu with the new menu item RELOAD, giving the user a relatively simple option.



Selecting RELOAD opens the RELOAD MATERIAL floating dialog box:



The following operations are required to rework the material:

<b>CAUTION:</b>	<p>The connected circuit board plotter will be set in motion when you execute the following steps.</p> <p>Make sure that no-one can access the working area of the circuit board plotter or come into contact with the tools while the operations controlled by BoardMaster are being executed.</p>
-----------------	---

**Procedure:**

1. Fix the circuit board to be machined on the plotter.
2. Select first reference point in *BoardMaster* (pad center point)
3. Move to the vertex selected with the a tool in the motor, a light spot or the camara option and import the coordinates of the first point.
4. Select the second reference point in *BoardMaster* (pad center point)
5. Move to the vertex selected with the light spot and import the coordinates of the second point.
6. Switch on and enable modify and rework the areas required.

Once a *Job*, which must contain the data for the circuit board that has already been produced and the data for reworking, has been opened, the circuit board to be reworked must be clamped in the plotter.

1. Highlight the 1ST POINT in the RELOAD MATERIAL dialog box to define the first reference point.
2. Select a significant point of the data that has already been completed in the graphic image. This should be a round or square soldering pad without conductor track connection.



3. Use the **Centre** or **Corner** buttons to move the highlight to the desired position. The centre point of the soldering pad is best. This is indicated on the screen by a cross.
4. Use the movement buttons to move the plotter head with the light spot over the point selected on the material.
5. Then click **Read**.

When this is complete, repeat the procedure with the 2nd point:

6. Select SOLDERING PAD - HIGHLIGHT CENTRE POINT - MOVE LIGHT SPOT - IMPORT COORDINATES.

This 2nd point should be as far as possible from the first point to increase precision.

7. Checking the SWITCH ON check box enables data alignment.

**Modify** stretches or squeezes the data according to the points entered. The rotation or shift is not displayed on the screen to prevent the data being misaligned in the subsequent machining of circuit boards.

8. The data to be processed can now be selected in *BoardMaster* and reworked.
9. Finally, deselect the SWITCH ON check box to prevent alignment of the data for later jobs and close the dialog box by clicking on **OK**.

# Step by Step

This section once again runs through the principles behind the procedure for prototype production in *BoardMaster* step by step:

## ***Start BoardMaster***

1. Double-click on the BOARDMASTER 3.0 icon in the LPKF PROTOTYPING program group in the PROGRAM MANAGER to start *BoardMaster*.

## ***Configuring BoardMaster***

Configure *BoardMaster* the first time you load it; the parameters will then be saved to the \*.INI file when you close the program, so that they are available to you again the next time you start *BoardMaster*.

2. Define the serial interface by selecting the INTERFACE... line of the CONFIGURATION menu.
3. Also check the settings for the serial interface under PORT in the WINDOWS CONTROL PANEL.
4. Configure the circuit board plotter parameters by selecting the PARAMETERS... line of the CONFIGURATION menu.
5. Configure the tool parameters by selecting the DRILLING/MILLING HEAD line from the TOOL LIBRARY sub menu of the CONFIGURATION menu.
6. Configure the production phases by selecting the PHASES... line of the CONFIGURATION menu.

## ***Specify board size***

7. Specify the size of the board material to be machined using the SET X,Y MIN and SET X,Y MAX functions found in the MATERIAL sub menu of the CONFIGURATION menu.

## ***Open or create the job***

8. Open an existing job by selecting OPEN... line from the FILE menu or create a new job by selecting the NEW line of the FILE menu.

## ***Import production data***

9. Import LMD production data created by *CircuitCAM* or HP-GL project files already created by *BoardMaster* by selecting the LMD OR LPR... line from the IMPORT sub menu of the FILE menu.

**Assign tools**

10. Assign the appropriate tools/phases to the imported production data or projects by selecting the TOOL ASSIGNMENT line of the EDIT menu if BoardMaster has not been able to complete the assignment itself.

**Place production data**

11. Place the imported production data or projects by selecting the PLACEMENT... line from the EDIT menu

or

using the   buttons in the toolbar.

**Save job**

12. Save the job following placement of all projects by selecting the SAVE AS line from the FILE menu.


**Select production phase**

13. Select the next production phase to be processed from the PRODUCTION PHASE list box in the toolbar.

**Configure tools for automatic tool change**

14. If you are using a ProtoMat® 95s or LPKF 101 Automill circuit board plotter, configure the tool positions by clicking on the TOOL list box in the toolbar with the right mouse button.

**Enable Automotor**

15. Enable the *Automotor* function by clicking on  in the toolbar.

**Select data**

16. Select the data to be sent to the circuit board plotter using the selection buttons in the toolbar:



***Start drilling/milling operation for the production phase selected***


---

**CAUTION:**     The connected circuit board plotter will be set in motion when the following button in the toolbar is selected.

                      Make sure that no-one can access the working area of the circuit board plotter or come into contact with the tools while the operations controlled by BoardMaster are being executed.

---



18. Click on  in the toolbar to send the selected data for the current production phase to the circuit board plotter via the serial interface.

# Index

## A

Advance .....22  
 Arrow keys .....27; 38  
 Automatic control .....39  
 Automill .....20; 22; 42  
 Automotor .....39; 59

## B

Board size .....26; 27  
     Specify .....58  
 BoardMaster .....57  
     Configure .....58  
     Starting .....12

## C

Cancel selection .....43  
 Circuit board data .....14  
 Circuit board plotter .....6; 10; 27; 39  
     Controller variants .....17  
     Parameters .....17  
     Start .....60  
     Syntax .....19  
     Type .....20  
 CircuitCAM .....6  
 Command chain .....19  
 Component side .....25; 40  
 Configuration .....15; 58  
 Control .....39  
     SMCU .....17; 19  
 Controller .....6  
     MCU .....17; 18  
 Conventions .....6  
 Copper board material .....14; 26  
     Size .....14

## D

Data  
     Mark .....35  
     Select .....35; 43  
 Data transfer .....16; 17  
 Deselect .....41  
 Diameter .....21  
 Dispenser tools .....45  
 Drilling .....39  
 Drilling time .....21; 36  
 Drilling/Milling head .....21

## E

**Enable dispenser** .....50

## F

Folders .....11  
 Font .....34

## G

Getting started .....12

## H

Heads dialogue box .....23  
 HOME position .....18; 19; 28  
 HP-GL .....6; 14; 29; 30  
 Hybrid laser .....17

## I

Import .....29; 58  
 INI file .....10; 17; 18  
 Initialization run .....19  
 Installation .....9  
 Interface .....15  
     Parameters .....16  
     Protocol .....16

## J

Job .....14; 26; 30  
     Create new .....29  
     Open .....29; 58  
     Save .....29; 59

## L

LMD .....6; 29  
 LPKF AutoContac special function .....45  
 LPKF Automill .....22  
 LPR .....29; 31

## M

Machine parameters .....	17; 19
Manual control .....	38
Mark area .....	43
Materials supplied .....	9
MCH file .....	10
MCU controller .....	17; 18; 38; 41
Menu bar .....	14; 15
Milling .....	39
Milling contours .....	40
Milling lines .....	34
Milling speed .....	36
Milling/drilling motor .....	39
Mirror axis .....	19
Mouse pointer position .....	14
Movement using the mouse .....	38
Multiple use .....	37
Multiple uses .....	32

## N

Number of tool holders .....	20
------------------------------	----

## O

Optimum speed .....	22
---------------------	----

## P

Pause position .....	18; 19; 28
Pen .....	31
Placement functions .....	37
Plotter	
Parameters .....	17
Syntax .....	19
Type .....	14
Plotter head .....	19; 27; 28; 38; 39
Position .....	35
Point coordinate .....	43
Positioning .....	18; 26
Processing time .....	35
Production data	
Additional information .....	31
Import .....	58
Placement .....	59
Removal .....	31
Production phase .....	10; 14; 25; 36
Create new .....	25
Select .....	40; 59
Sequence .....	40
Start .....	60
Program disk .....	9
Program group .....	12; 58
Project .....	29; 31
Add .....	33
Centre .....	33
Create .....	30
Duplicate .....	37
Move .....	37
Placing .....	32

Remove .....	33
rotate .....	37
Project files .....	58
ProtoMat® .....	20
ProtoMat® 95s special functions .....	51
Prototype production .....	6

## R

Reference point .....	32; 37
Registration drillings .....	26
Resolution .....	20; 31
Reworking .....	56
Rotation .....	32

## S

Safety instructions .....	7; 27
Sample files .....	11
Screen detail .....	34
Scroll bars .....	14
Select LED .....	38
Selection buttons .....	59
Selection functions .....	43
Serial interface .....	15
Service life .....	22; 35; 42
SMCU control .....	17; 19
SMCU controller .....	38
Solder side .....	25; 40
Speed .....	20
Speed of rotation .....	36
Start button .....	44
Status bar .....	14
Status information .....	35
StencilLaser .....	17
Step pitch for manual control .....	36
Stop button .....	44
Suction tools .....	46
System requirements .....	9

## T

Teach In .....	54
Test operation .....	16
Text display .....	34
Through-hole plating .....	25
Title bar .....	14; 20
Tool .....	36
Assign .....	59
Change positions .....	20
Magazine .....	42
Position .....	42
Speed .....	20
Traverse speed .....	20
Tool change .....	7; 22; 39; 41; 42; 59
Automatic .....	42
Manual .....	41
Tool change position .....	28
Tool library .....	6; 10; 21
Tool magazine .....	53
Toolbar .....	14; 35



---

Traverse speed.....20  
Tutor.job .....14

## U

Unit.....20  
Update note .....10  
User interface ..... 12; 13

## V

Variable parameters.....36

Vector index.....36

## W

Windows system font.....34  
Windowsinterface .....6  
Working folder ..... 11  
Workspace..... 14; 18; 21; 25; 26

## Z

Zoom .....34

